



Working with Troubles and Failures in Conversation Between Humans and Robots

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ABSTRACT

In order to carry out human-robot collaborative tasks efficiently, robots have to be able to communicate with their human counterparts. In many applications, speech interfaces are deployed as a way to empower robots with the ability to communicate. Despite the progress made in speech recognition and (multi-modal) dialogue systems, such interfaces continue to be brittle in a number of ways and the experience of the failure of such interfaces is commonplace amongst roboticists. Surprisingly, a rigorous and complete analysis of communicative failures is still missing, and the technical literature is positively skewed towards the success and good performance of speech interfaces. In order to address this blind spot and investigate failures in conversations between humans and robots, an interdisciplinary effort is necessary. This workshop aims to raise awareness of said blind spot and provide a platform for discussing communicative troubles and failures in human-robot interactions and potentially related failures in non-robotic speech interfaces. We aim to bring together researchers studying communication in different fields, to start a scrupulous investigation into communicative failures, to begin working on a taxonomy of such failures, and enable a preliminary discussion on possible mitigating strategies. This workshop intends to be a venue where participants can freely discuss the failures they have encountered, to positively and constructively learn from them.

CCS CONCEPTS

• **Human-centered computing**; • **Computing methodologies**
→ **Natural language processing**; **Discourse, dialogue and pragmatics**;

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KEYWORDS

human-robot interaction, speech interfaces, conversation analysis, pragmatics

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1 INTRODUCTION

If designed and developed efficiently, human interactions with robotic systems have great potential to enhance human abilities, well-being, and human-robot cooperation. Communication is a crucial aspect of successful interaction and has been studied by various academic fields such as human-computer interaction (HCI), linguistics, cognitive science, conversation analysis, and artificial intelligence (AI). There are different ways to conceptualise interaction and communication. Interaction as *joint action* implies that communication is a participatory process in which participants have shared goals [2]. For this, the iterative process of establishing shared meaning and recovering such meaning once it is lost is fundamental. The capability to use and process human language, as well as other embodied means of communication such as gestures or facial expressions, are crucial for the needed information exchange in human-robot interactions. As a result, speech interfaces are commonplace in many types of robots and robotic applications. Despite the progress in speech recognition, and many other areas of natural language processing (NLP) such as multi-modal dialogue systems, failures of speech interfaces in robotic scenarios are numerous and commonplace. In contrast to the common experience of failure of such interfaces in robotics, the literature is positively skewed towards reports of their success and good performance. Contrary to substantial work on the central role of failures and their accompanying repair mechanisms in human-human conversations (cf. [3] [1]), a systematic study of communicative failures

and their causes in human-robot interaction is by and large lacking. However, studying them in a depth akin to the one witnessed in conversation analysis holds the promise of pointing out new future directions for research in robotic speech interfaces. Such efforts are also needed to arrive at the definition of possible solutions to the different types of failures. While some taxonomies of general robot failures have been proposed (e.g. [4]), a rigorous examination is lacking with respect to failures in speech-driven interactions. Moreover, a deeper analysis of situations arising from interaction failures could enable both the HRI and HCI communities to study how robots and similar devices should communicate failure, how people perceive and resolve robot failures, how failures influence people's perceptions and feelings towards robots, and how these effects can be mitigated. Understanding failures is fundamental to advance communication in both human-robot and human-computer interaction. We therefore advocate that they should not be simply disregarded, hidden, or immediately corrected without further analysis, as they offer opportunities to learn and design better interactions. For this reason, this workshop aims at being a venue to freely and honestly discuss failures in (multi-modal) speech-driven interfaces, as a starting point to establish research on communicative failures as a valid area of research within HRI and HCI and to advance conversations between humans and robots.

2 OUTLINE OF THE WORKSHOP

The central idea of the workshop is to discuss the multitude of failures of speech interfaces openly and, if possible, systematically, in the hope of: 1) defining a taxonomy of communicative failures, and 2) identifying the most fruitful directions for overcoming these failures in future systems. The envisioned types of failures may range from failures of speech recognition to pragmatic failures and infelicities. While the workshop's focus are human-robot joint action scenarios, relevant experience and input from the HCI community are very much welcome. This workshop builds upon the needs identified during a UK-based version of this workshop, funded by the UK-RAS network and held in September 2022 at the University of Hertfordshire (cf. <https://sites.google.com/view/wtfworkshop2022/overview>). The proposed workshop is aimed at opening the topic to an international audience and continuing the interdisciplinary effort of the first one.

2.1 Format and Activities

This is a full-day hybrid workshop. To encourage participation and improve the accessibility of the workshop, it will be run in person and over Zoom. This way, speakers and participants who cannot travel to the conference will still be able to present and participate in the discussion. We will support remote participation in the discussion by appointing a member of the organising committee to monitor the chat, encourage remote participants to engage in the conversation, and perform in-person tasks on their behalf, when needed. The workshop is divided into two sessions. The morning session will be mainly organised around presentations, so that participants will have the possibility to understand each others' backgrounds and current research. This will include 3 keynotes followed by bash talks: participants will be given 3 to 5 minutes each, depending on the number of submissions received, to talk

about their experiences with failures. In the afternoon, after the fourth keynote, the organisers will encourage the discussion by organising a "rotating panel". This activity will see participants taking turn as members of the panel to discuss the key topics of the workshop, identified based on their submissions. To facilitate the discussion, videos portraying examples of failures will be shown to participants.

2.2 Main Topics of Interest

Topics of interest include, but are not limited to:

- Multi-modal communication & dialogue systems
- Human-robot communication design
- Speech interfaces
- Joint action research
- Interaction design
- Pragmatics & Conversation analysis
- Shared meaning understanding
- Natural language processing
- Speech recognition
- Failure recovery

2.3 Invited Speakers

We have reached out to the following experts to present a keynote speech at the workshop to provide input to the discussion from the perspective of their respective research areas, which are all touching on troubles and failures in conversation between humans and robots.

- **Manuel Giuliani**, Professor in Embedded Cognitive AI for Robotics at the Bristol Robotics Laboratory (UK). His research interests include human-robot interaction, error and failure detection and recovery, socially awkward robots. He is a co-editor of the "Imperfect Human-Robot Interactions" Frontiers Research Topic.
- **Verena Rieser** (to be confirmed), Professor at the School of Mathematical and Computer Sciences (MACS) at Heriot-Watt University (UK). She recently joined Google DeepMind and her research specialises on natural-language generation and spoken dialogue systems, including conversational modelling as well as studies of how gender cues in synthetic language can trigger biases in the people who interact with them.
- **Mark Dingemanse**, Professor in Language and Communication at Radboud University Nijmegen (the Netherlands) and part of the Multimodal Language & Cognition research group at the Max Planck Institute for Psycholinguistics. His current work focuses on multi-modal alignment and mutual understanding by developing solutions and computational models of knowledge updating, including universal principles for repairing communication problems.
- **Katharina Rohlfing**, Professor for Psycholinguistics at the University of Paderborn (Germany). Her research interests include language acquisition, cognitive development, developmental robotics, and multimodal interaction more generally, as well as explainable autonomous systems.

3 TARGET AUDIENCE

The workshop wants to address troubles and failures in communication by gathering, comparing, and combining knowledge from a multidisciplinary group of researchers from robotics, HRI, HCI, AI, NLP, conversation analysis and pragmatics. For this reason, with the aim of attracting participants from all the aforementioned fields, no strict prerequisite will be enforced, although it would be beneficial for participants to have experience with communication problems and speech interfaces failures. We expect between 20 to 30 participants.

3.1 Tentative Schedule

09:30 - 10:00 Welcome and introduction to HRI
 10:00 - 10:30 Keynote: **Manuel Giuliani**
 10:30 - 11:00 Keynote: **Verena Rieser (tbc)**
 11:00 - 11:20 *Coffee break*
 11:20 - 12:20 Keynote: **Mark Dingemans**
 12:20 - 13:00 Participant bash talks
 13:00 - 14:00 *Lunch break*
 14:00 - 15:00 Keynote: **Katharina Rohlfing**
 15:00 - 15:30 Existing taxonomies
 15:30 - 15:50 *Coffee break*
 15:50 - 16:45 Rotating panel
 16:45 - 17:00 Closing remarks

4 RECRUITMENT OF PARTICIPANTS

The call for participation for this workshop will be distributed via mailing lists (i.e., hri-announcement, chi-announcements, robotics-worldwide) and social media. To encourage the participation of a multidisciplinary and diverse audience we will also advertise the workshop to mailing lists such as corpora-list (aimed at researchers working on NLP), the Vocal Interactivity in-and-between Humans, Animals and Robots (VIHAR) mailing list, and the Women in Machine Learning mailing list. A website will be created to provide information about the workshop, similar to <https://sites.google.com/view/wtfworkshop2022/overview>, where prospective participants will find information on the format and schedule of the workshop, and on the keynotes. Prospective participants will be invited to submit 2-4 pages extended abstracts on research related to the topics described above. We will explicitly encourage the submission of papers describing encountered problems and failures when working with speech interfaces. All manuscripts will be peer-reviewed based on relevance to the workshop.

5 DOCUMENTATION AND DISSEMINATION

Participant's contributions will be collected and made available in workshop proceedings on *arXiv (cs.RO)* (<https://arxiv.org>), retaining authors the possibility to opt-out. Participants will also be encouraged to submit an extended version of their abstract to a special issue in *Frontiers in Robotics and AI* (<https://www.frontiersin.org/journals/robotics-and-ai>) edited by the organising committee. After being peer-reviewed, a selection of the workshop papers will be published in that special issue (*Note: Frontiers has expressed strong interest in publishing a special issue on this topic with official confirmation still pending at the time of writing*). To foster ongoing engagement with the community, we will keep the workshop's

website up to date after the workshop has finished and create a workspace on *slack* (<https://slack.com>) where we invite workshop participants and other interested parties to join.

6 ORGANISERS

Frank Förster is a Senior Lecturer at the School of Physics, Engineering and Computer Science at the University of Hertfordshire (UK), a member of the Robotics Research Group, and associated with the Adaptive Systems Research Group. His research is located at the intersection of developmental robotics and human-robot interaction, focusing mostly on deciphering and, eventually, operationalising, the social factors and driving forces underlying language acquisition in particular, and human intelligence more generally. Frank is co-investigator of the EPSRC project *Fluidity in simulated human-robot interaction with speech interfaces*.

Marta Romeo is an Assistant Professor in Computer Science at Heriot-Watt University, Edinburgh (UK). She received her PhD in socially assistive robotics for independent living within the H2020 MoveCare project at the Cognitive Robotics Lab at the University of Manchester (UK). Her current research, within the UKRI TAS Node on Trust, focuses on investigating how trust between humans and robots can be built, maintained, and recovered.

Patrick Holthaus is a Senior Research Fellow in the Robotics Research Group and manager of the Robot House facility at the University of Hertfordshire (UK). His research revolves around social robotics and focuses on nonverbal interactive signals, social credibility and trust in assistive and companion robots. Patrick has recently been involved as a CoI of the UKRI TAS hub's pump priming project *Kaspar explains*, the EPSRC Network+ project *EMERGENCE*, and the EU ERASMUS+ project *EMBOA*.

Birthe Nessel is a PhD candidate at Heriot-Watt University, researching trustworthy behaviour in Human-Robot Interactions. Her PhD is part of the UKRI TAS Node on Trust, focusing on the impact robot transparency has on users' trust when robot errors take place. She has an interdisciplinary background in computer science and psychology, combining the two in her research on different aspects of robot failures.

Maria J. Galvez Trigo is an Assistant Professor in Computer Science at the University of Lincoln, member of the Interactive Technologies Lab, and the Lincoln Centre for Autonomous Systems. Her research is multidisciplinary, focused on HRI and Autonomous Systems, exploring trust in these systems, as well as control interfaces and multi-modal interactions that could improve the accessibility and inclusiveness of these technologies. Although her work spans various sectors, she is mostly interested in Assistive Robotics and Educational Robotics.

Christian Dondrup is an Assistant Professor of Computer Science at the School of Mathematical and Computer Sciences at Heriot-Watt University, UK. Christian is Co-I on the SPRING H2020 EU project and before that was a Post-Doctoral Research Fellow on the MuMMER H2020EU project. His work on both these projects focused on integrating Natural Language Processing and task execution on humanoid robots for HRI. This has put him at the forefront of dealing with troubles and failures of both verbal and non-verbal actions of robots.

Joel Fischer is Professor of Human-Computer Interaction at the School of Computer Science, University of Nottingham, UK. He is currently Research Director of the UKRI Trustworthy Autonomous Systems (TAS) Hub where he is involved in a number of projects on HRI. His work on interaction with Voice User Interfaces has made use of Conversation Analysis to show how participants deal with troubles and failures in and through talk-in-interaction.

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